Shoreline Stabilization

Bioengineering Alternatives

People are naturally drawn to water. Everybody has probably imagined how wonderful it would be to have their yard open out onto a lake, with a boat tied up at the dock for a quick escape to sun and fun on the water. Unfortunately, many people who have turned this dream into reality have found that it can be less than wonderful to watch their yard slowly slump into the lake, bringing the lakeshore closer to their doorstep each year.

Shoreline erosion has several common causes. Home-owners routinely replace the native plants that are adapted to shoreline conditions with non-native species like turfgrasses that are not well-suited to the stresses of the lakeshore. Dredging and filling associated with development can drastically change the shoreline slope and reduce the soil's stability. Additionally, boat-generated waves can increase stress on the shoreline.

The traditional solution to shoreline erosion problems has been to place man-made materials on the shoreline. Common examples of this are seawalls of steel, cement, or railroad ties; riprap armoring; or strategically placed piles of broken concrete or asphalt. Makeshift applications often fail to halt the erosion process, and a well-designed (and thus effective) seawall or riprap installation can be prohibitively expensive.

Over the past decade, ***bioengineering*** solutions have been developed as alternatives to these traditional methods. Bioengineering combines structural engineering principles with the use of vegetation for shoreline stabilization and erosion control. The use of vegetation in stabilizing shorelines is a low-cost, highly-effective means of solving erosion problems. By using native vegetation with extensive root systems, the soil in the banks is bound together by the roots. The above-ground portion of the plants dissipates the energy of erosive waves, creating quiet water areas along the bank that can even allow sediment to accumulate, rather than erode. By selecting native plant species, the application becomes self-sustaining and, to an extent, self-repairing since the plants are adapted to grow and reproduce under shoreline conditions. The use of native vegetation also restores some of the look and feel of the original shoreline, including enhanced habitat for all sorts of wildlife.

Bioengineering techniques have several advantages over "traditional" engineering techniques. Installation costs for a bioengineering solution can range from $10 to $80 per foot of shoreline, while traditional approaches can cost $60 to $175 per foot. Repair of traditional stabilization measures is expensive and typically requires professional contractors. In contrast, maintenance and repair of a bioengineered installation often can be handled by the property owner—at a cost primarily measured in time rather than money.

To be fair, conventional stabilization practices may still be appropriate in some situations, such as larger lakes with extreme water level fluctuations or excessive wave action. Further, because it takes some time for vegetation to become fully established, bioengineeringsolutions are not an instant fix and typically require some follow-up monitoring and maintenance.

This *Lake Notes* publication is intended to introduce you to bioengineering methods and materials that can be used for effective bank stabilization. Initial installation of these methods generally should be done in consul-tation with a professional, taking into account conditions unique to your site.

The selection of a specific technique at a particular shoreline location will depend on a number of suitability and cost factors, including the following:

- pre-settlement vegetation conditions
- the degree and duration of water level fluctuation
- the severity of wave action
- the steepness of the shoreline
- soil/substrate conditions
- the orientation of the slope to the sun
- the severity of existing erosion
- adjacent land uses and related aesthetic considerations
- maintenance needs
- installation and maintenance costs

Several common bioengineering methods are described in the following sections. Choosing among them is not an either/or proposition: sometimes a combination of two or more methods is more appropriate than any single method.

When assessing costs, remember that it is rare for stabilization to be needed continuously along an entire shoreline. Instead, bioengineering measures are used only where necessary to address stretches of moderate to severe erosion. The remainder of the shoreline may only require preventative maintenance, such as replacement of unstable turf with deep-rooted native plants.

Vegetative Stabilization

Vegetative stabilization involves planting appropriate native vegetation on shorelines and in shallow-water zones (see the *Lake Notes* publication "Shoreline Buffer Strips" for a list of plant species). Vegetative stabilization is most appropriate where erosion problems are not already severe and on relatively flat slopes (typically 2:1–3:1 horizontal to vertical, or flatter). Vegetative measures also work well in combination with structural bioengineering techniques for more serious problems, and as a preventative technique to replace conventional turfgrass landscaping before significant erosion begins.

Vegetative stabiliz-ation typically begins with the removal of existing non-native, undesirable veget-ation, especially if it shades out desirable plants. Stumps of woody vegetation—particularly buckthorn—must be treated with an appropriate herbicide to prevent re-sprouting. Herbicides of this type usually require a licensed applicator. Next, minor bank regrading may be necessary to create a stable slope. This is followed by the introduction of plugs or seeds of native vegetation and installation of temporary soil stabilization measures, like an erosion control blanket and/or cover crop, until the new vegetation becomes fully established.

UNDESIRABLE SPECIES!

Common Name	Species Name
Box Elder	*Acer negundo*
Garlic Mustard	*Allilaria officianalis*
Japanese Honeysuckle	*Lonicera japonica*
Tartarian Honeysuckle	*Lonicera tatarica*
Purple Loosestrife	*Lythrum salicaria*
Reed Canary Grass	*Phalaris arundinacea*
Common Buckthorn	*Rhamnus athartica*
Glossy Buckthorn	*Rhamnus frangula*
Multiflora Rose	*Rosa multiflora*

Nearshore, shallow-water areas should be planted with emergent wetland vegetation to dissipate wave energy. This wetland zone typically ranges from one-half to one foot above <u>and</u> below the normal water elevation.

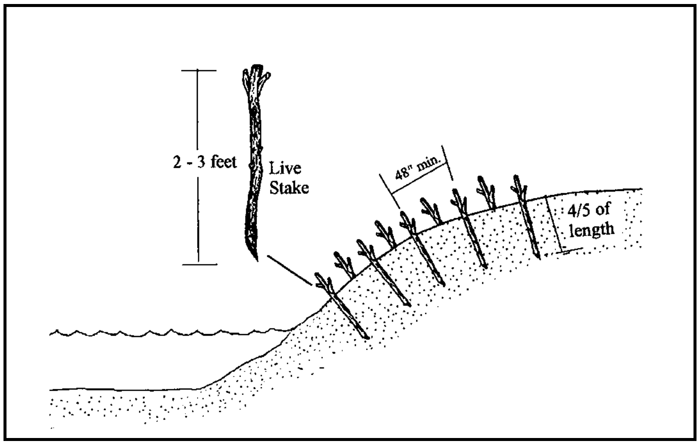
The principal advantage of vegetative stabilization is that installation is simple and often can be implemented by property owners or volunteers. Advice on plant selection is best sought from an expert. Effectiveness is dependent on the presence of good soils. The approximate cost of vegetative stabilization is $10 per linear foot of shoreline.

Long-term maintenance requirements involve annual or biennial controlled burns (or mowing) to control non-native plants and prevent invasion by undesirable woody plants. Selective use of an approved herbicide also may be helpful in controlling invasive weed species until the native vegetation is fully established.

Live Stakes *(the "Willow Post" method)*

In certain natural shoreline settings, the areas exhibiting the greatest stability often are colonized by woody riparian brush or shrubs such as buttonbush, red-osier dogwood, and sandbar willow (see the *Lake Notes* publication "Shoreline Buffer Strips" for additional species). These plants have extensive fibrous root systems that grow towards the water, thereby stabilizing the soil. These and other riparian species often can propagate themselves when live branches break off, float, and root where they run aground on a suitable substrate. Because these shrubs tend to quickly establish themselves on shoreline areas, they can be used to provide rapid erosion control. This technique often is used in conjunction with other methods, such as fiber rolls or A-Jacks (see later sections).

Live stakes are obtained by harvesting cuttings from an existing stand of the desired shrub(s) during the dormant season (October–March). The cuttings should be ½ to 1½ inches in diameter and 2 to 3 feet long, retaining at least two buds near the top end. The cuttings are "planted" in a dormant state, typically in early spring or late fall, into pilot holes set on random centers roughly 4 to 5 feet apart in the shoreline. A seeded cover crop is recommended while the cuttings are becoming established.



Live stake (willow post) installation.

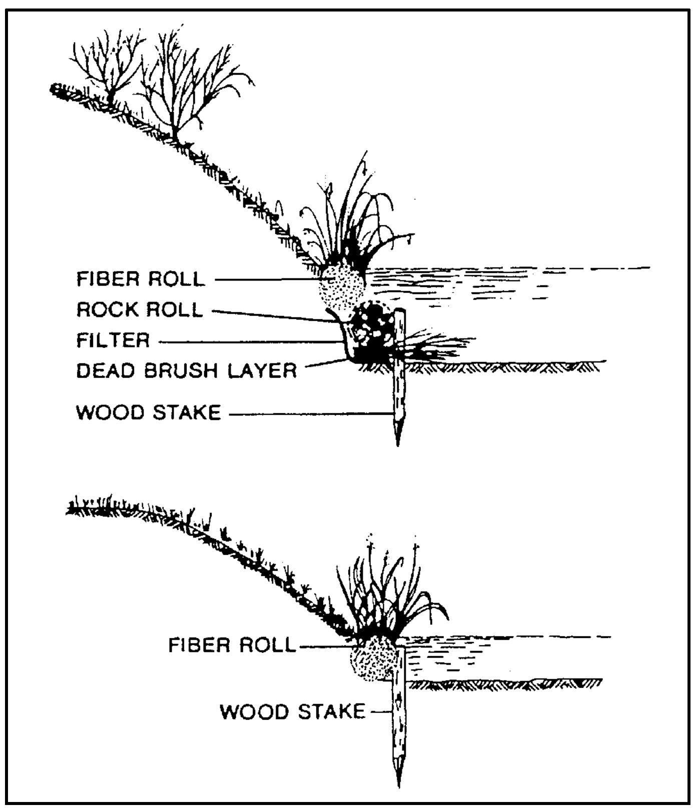
An advantage of this method, like basic vegetative stabilization, is that installation is simple and does not require skilled labor. Effectiveness is best in locations where good soil or subsoil (versus poor fill) exists and where water level fluctuations are not severe. If erosion problems are severe or rapidly advancing, this technique may need to be combined with structural methods to provide immediate stabilization. Maintenance requirements involve occasional pruning, trimming, and disposal of brush. Installation cost is approximately $10 to $20 per linear foot of shoreline.

A final consideration regarding the live stake method is the aesthetics of thick stands of shrubs along the shoreline. Being substantially taller than wetland plants and prairie grasses, shrubs may obscure views and limit access to the lake. Consequently, this method may be most appropriate in more isolated locations where direct shoreline access is not necessary.

Fiber Rolls

Fiber rolls are sausage-like cylinders of compacted fiber (typically coconut husk), wrapped with a fiber mesh. Roughly the diameter of a basketball, the rolls are set in the shallow water zone next to the shoreline and staked into place. Once saturated with water, the rolls become very heavy and difficult to move. The rolls help to dissipate wave energy and trap eroded sediments, thereby providing a protected zone along the shoreline. This zone, as well as the rolls themselves, are planted with aquatic emergent vegetation. Native grasses, wild-flowers, and shrubs are planted on the shoreline. Being completely biodegradable, the rolls will break down in 5 to 7 years. In the intervening time, however, the introduced native vegetation becomes so well established that it provides long-term shoreline stabilization.

The principal advantage of fiber rolls is the ability to provide immediate shoreline protection by dissipating the erosive force of small waves. Fiber rolls provide an added advantage of trapping eroding shoreline soils, keeping the sediment out of the body of the lake and providing a good medium for plant establishment. With these characteristics, fiber rolls are able to repair more severe erosion problems than vegetation alone. Fiber roll installation costs about $25 to $35 per linear foot of shoreline. Maintenance requirements are minimal. Short-term inspection is recommended to ensure that fiber rolls remain firmly anchored in place.



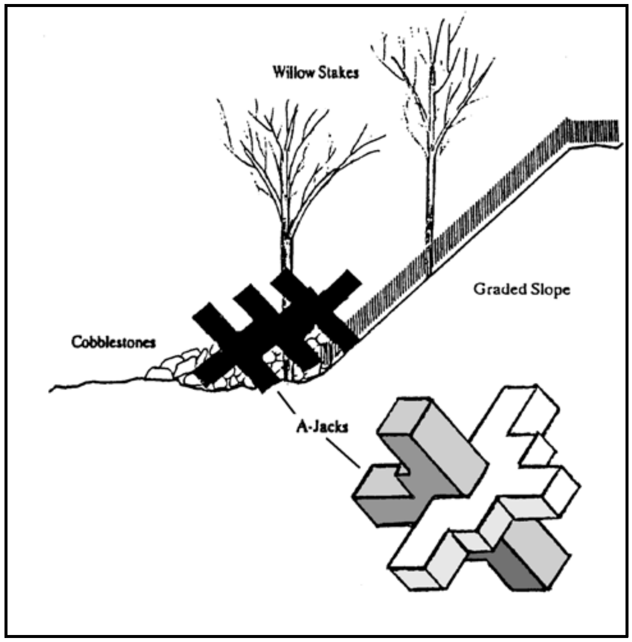
Fiber roll installation.

A-Jacks

An A-Jacks structure is comprised of two identical pieces of pre-cast concrete that when fitted together form a 6-legged structure similar to childrens' playing jacks. The assembled A-Jacks is approximately 2-foot square and weighs about 70 pounds. A-Jacks structures are nested together in a linear fashion into a shallow trench excavated along the "toe" of an eroding shoreline. The toe is the zone where the normal water surface meets the shoreline slope; its protection is critical to shoreline stabilization.

Once installed, the void spaces within the A-Jacks structures are filled with an erosion control product, and covered with soil. The backfilled area is then planted with native species of shrubs, grasses, and wildflowers. The roots of these plants eventually wrap around the buried A-Jacks structures and penetrate the underlying parent soil material, creating a living system of erosion control. By being flexible, the A-Jacks structures can shift without cracking or failing. Further protection from wave action can be provided by placing a fiber roll on the lake side of the A-Jacks.

The advantages of A-Jacks are their ability to provide immediate erosion protection at the toe of an eroding slope and to protect adjacent slopes from scour during plant propagation. A disadvantage of A-Jacks is that installation is somewhat labor intensive and requires equipment for excavation and backfilling. The cost of A-Jacks installation ranges from $30 to $75 per linear foot of shoreline, depending on the severity of the existing erosion problem. Maintenance is minimal beyond inspecting the initial installation.



A-Jacks installation.

Agencies and Groups to Contact for Further Assistance

Chicago Botanic Garden
Plant Information Center
(847) 835-0972

Illinois EPA-Lakes Unit
Springfield, Illinois
(217) 782-3362

Illinois State Water Survey
Peoria, Illinois
(309) 671-3196

Lincoln Memorial Garden
Springfield, Illinois
(217) 529-1111

Local Soil & Water Conservation Districts:
and USDA-Natural Resource Conservation
Service offices

Missouri Botanical Garden
Horticulture Answer Service
(314) 577-5143

Northeastern Illinois Planning Commission
Natural Resources Department
Chicago, Illinois
(312) 454-0400

U.S. Fish & Wildlife Service
Chicago Field Office
Barrington, Illinois
(847) 381-2253

Lake Notes is a series of publications produced by the Illinois Environmental Protection Agency about issues confronting Illinois' lake resources.

The objective of these publications is to provide lake and watershed residents with a greater understanding of environmental cause-and-effect relationships, and actions we all can take to protect our lakes.

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For more information about other publications in this series and to request copies, please contact: Illinois Environmental Protection Agency, DWPC-Lake and Watershed Unit, P.O. Box 19276, Springfield, Illinois, 62794-9276; 217/782-3362.